

MATTHÄUS KIEL - CURRICULUM VITAE

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ACADEMIC EDUCATION

Ph.D. in Physics (Dr. rer. nat.)	May 2013 – July 2016
Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany	
Advisor: Professor Dr. Johannes Orphal	
Research Fellowship by German Academic Exchange Service	April 2015 - June 2015
California Institute of Technology (Caltech), Pasadena, CA	
Advisor: Professor Dr. Paul O. Wennberg	
Master of Science in Physics	Oct. 2010 – Oct. 2012
Rheinische Friedrich-Wilhelms-Universität (RFWU), Bonn, Germany	
Advisor: Professor Dr. Klaus Lehnertz	
Bachelor of Science in Physics	Oct. 2006 – Oct. 2010
Rheinische Friedrich-Wilhelms-Universität (RFWU), Bonn, Germany	
Advisor: Professor Dr. Klaus Desch	

RESEARCH EXPERIENCE

NASA Jet Propulsion Laboratory , Pasadena, CA	June 2019 – present
<i>Research Scientist in Earth Science Division</i>	
<ul style="list-style-type: none">Evaluate and validate satellite observations derived from NASA's Orbiting Carbon Observatory-2 (OCO-2) and NASA's Orbiting Carbon Observatory-3 (OCO-3) using independent measurements from multiple remote sensing platforms and model dataImprove retrievals of the Atmospheric Carbon Observations from Space (ACOS) algorithm used for OCO-2, OCO-3, and the Greenhouse Gas Observing Satellite (GOSAT)Address cross-cutting challenges in the anthropogenic footprint of carbon and its relationship to air quality using novel methods for the identification and quantification of fossil fuel carbon dioxide emissions on local scalesScience support for multiple OCO-2 and OCO-3 project teams including calibration, algorithm, validation, and mission planning	

Caltech, Wennberg Research Group , Pasadena, CA	Aug. 2016 – June 2019
<i>Postdoctoral Scholar in Environmental Science and Engineering</i>	
<ul style="list-style-type: none">Studied the terrestrial carbon cycle and anthropogenic carbon dioxide emissions using satellite data, ground-based remote sensing observations, airborne in-situ measurements, and model dataValidated satellite data derived from NASA's OCO-2 using high resolution ground-based Fourier transform infrared (FTIR) spectraAnalyzed and calibrated data from the Total Carbon Column Observing Network (TCCON)Improved retrievals of the Atmospheric Carbon Observations from Space (ACOS) algorithm used for OCO-2, OCO-3, and GOSATOperated high-resolution ground-based and portable FTIR spectrometers	

KIT, Remote Sensing Research Group, Karlsruhe, Germany
Research Assistant

May 2013 – July 2016

- Identified and quantified error sources in the retrieval of atmospheric trace gas abundances using ground-based solar FTIR measurements in the Network for the Detection of Atmospheric Composition Change (NDACC) and TCCON
- Synthesized atmospheric retrievals of trace gas abundances from NDACC and TCCON measured in different spectral regions to improve the spatial and temporal coverage over each individual network

RFWU, Neurophysics Research Group, Bonn, Germany
Research Assistant

Oct. 2011 – Oct. 2012

- Characterized complex networks using linear and non-linear time series analysis techniques
- Established new methods to quantify synchronization phenomena in brain dynamics by simulation of neurons with coupled chaotic oscillators

PROGRAMMING AND STATISTICAL ANALYSIS SKILLS

- Python, Matlab, Fortran, IDL, bash scripting, LaTeX, Origin Pro, revision control (GIT/Mercurial), MySQL, high performance parallel computing, semi-automated scripting, Bayesian techniques in remote sensing, statistical analyses, error analyses, handling and storage of large datasets

PROGRAMMING PROJECTS

- Development and maintenance of a non-linear least-squares fitting algorithm (GGG2014) designed to derive atmospheric trace gas abundances from high resolution solar spectra
- Development of add-in software (Calpy) as a pre-processor for non-linear least-squares fitting algorithms, specifically designed to use with Bruker EM27/SUN spectrometers
- Development and administration of patient databases using MySQL including online visualization tools for large datasets

LANGUAGES

- Fluent in English and German, proficient in Polish

AFFILIATIONS

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| • European Geosciences Union (EGU) | Jan. 2016 – present |
| • American Geophysical Union (AGU) | May 2015 – present |
| • Total Carbon Column Observing Network (TCCON) | May 2015 – present |

LIST OF PUBLICATIONS

- 2020 Byrne, B., Liu, J., Lee, M., Baker, I., Bowman, K., Deutscher, N., Feist, D., Griffith, D., Iraci, L., **Kiel, M.**, Kimball, J., Miller, C., Morino, I., Parazoo, N., Petri, C., Roehl, C., Sha, M., Strong, K., Velazco, V., Wennberg, P., and Wunch, D.: *Improved constraints on northern extratropical CO₂ fluxes obtained by combining surface-based and space-based atmospheric CO₂ measurements*, J. Geophys. Res.-Atmos., in review, 2020
- 2019 Kulawik, S. S., Crowell, S., Baker, D., Liu, J., McKain, K., Sweeney, C., Biraud, S. C., Wofsy, S., O'Dell, C. W., Wennberg, P. O., Wunch, D., Roehl, C. M., Deutscher, N. M., **Kiel, M.**, Griffith, D. W. T., Velazco, V. A., Notholt, J., Warneke, T., Petri, C., De Mazière, M., Sha, M. K., Sussmann, R., Rettinger, M., Pollard, D. F., Morino, I., Uchino, O., Hase, F., Feist, D. G., Roche, S., Strong, K., Kivi, R., Iraci, L., Shiomi, K., Dubey, M. K., Sepulveda, E., Rodriguez, O. E. G., Té, Y., Jeseck, P., Heikkinen, P., Dlugokencky, E. J., Gunson, M. R., Eldering, A., Crisp, D., Fisher, B., and Osterman, G. B.: *Characterization of OCO-2 and ACOS-GOSAT biases and errors for CO₂ flux estimates*, Atmos. Meas. Tech. Discuss., in review, 2019
- Hedelius, J. K., He, T.-L., Jones, D. B. A., Baier, B. C., Buchholz, R. R., De Mazière, M., Deutscher, N. M., Dubey, M. K., Feist, D. G., Griffith, D. W. T., Hase, F., Iraci, L. T., Jeseck, P., **Kiel, M.**, Kivi, R., Liu, C., Morino, I., Notholt, J., Oh, Y.-S., Ohyama, H., Pollard, D. F., Rettinger, M., Roche, S., Roehl, C. M., Schneider, M., Shiomi, K., Strong, K., Sussmann, R., Sweeney, C., Té, Y., Uchino, O., Velazco, V. A., Wang, W., Warneke, T., Wennberg, P. O., Worden, H. M., and Wunch, D.: *Evaluation of MOPITT Version 7 joint TIR–NIR XCO₂ retrievals with TCCON*, Atmos. Meas. Tech., 12, 5547–5572, 2019.
- Frey, M., Sha, M. K., Hase, F., **Kiel, M.**, Blumenstock, T., Harig, R., Surawicz, G., Deutscher, N. M., Shiomi, K., Franklin, J., Bösch, H., Chen, J., Grutter, M., Ohyama, H., Sun, Y., Butz, A., Mengistu Tsidu, G., Ene, D., Wunch, D., Cao, Z., Garcia, O., Ramonet, M., Vogel, F., Orphal, J.: *Building the COllaborative Carbon Column Observing Network (COC-CON): Long term stability and ensemble performance of the EM27/SUN Fourier transform spectrometer*, Atmos. Meas. Tech., 12, 1513–1530, 2019
- Kiel, M.**, O'Dell, C. W., Fisher, B., Eldering, A., Nassar, R., MacDonald, C. G., and Wennberg, P. O.: *How bias correction goes wrong: Measurement of XCO₂ affected by erroneous surface pressure estimates*, Atmos. Meas. Tech., 12, 2241–2259, 2019
- 2018 O'Dell, C. W., Eldering, A., Wennberg, P. O., Crisp, D., Gunson, M. R., Fisher, B., Frankenber, C., **Kiel, M.**, Lindqvist, H., Mandrake, L., Merrelli, A., Natraj, V., Nelson, R. R., Osterman, G. B., Payne, V. H., Taylor, T. R., Wunch, D., Drouin, B. J., Oyafuso, F., Chang, A., McDuffie, J., Smyth, M., Baker, D. F., Basu, S., Chevallier, F., Crowell, S. M. R., Feng, L., Palmer, P. I., et al.: *Improved Retrievals of Carbon Dioxide from the Orbiting Carbon Observatory-2 with the version 8 ACOS algorithm*, Atmos. Meas. Tech., 6539–6576, 2018
- Borsdorff, T., aan de Brugh, J., Hu, H., Hasekamp, O., Sussmann, R., Rettinger, M., Hase, F., Gross, J., Schneider, M., Garcia, O., Stremme, W., Grutter, M., Feist, D. G., Arnold, S. G., De Mazière, M., Kumar Sha, M., Pollard, D. F., **Kiel, M.**, Roehl, C., Wennberg, P. O., Toon, G. C., and Landgraf, J.: *Mapping carbon monoxide pollution from space down to city scales with daily global coverage*, Atmos. Meas. Tech., 11, 5507–5518, 2018

Oh, Y.-S., Kenea, S. T., Goo, T.-Y., Kim, G., Chung, K.-S., Rhee, J.-S., Ou, M.-L., Byun, Y.-H., Wennberg, P. O., **Kiel, M.**, Velazco, V. A., Oh, M.-L., and Griffith, D. W. T: *Characteristics of the Greenhouse Gas Concentration Derived from the Ground-based FTS Spectra at Anmyeondo, Korea*, Atmos. Meas. Tech., 11, 2361-2374, 2018

- 2017 Barthlott, S., Schneider, M., Hase, F., Blumenstock, T., **Kiel, M.**, Dubravica, D., Garcia O. E., Sepulveda, E., Mengistu Tsidu, G., Takele Kenea, S., Grutter, M., Stremme, W., Strong, K., Weaver, D., Palm, M., Warneke, T., Notholt, J., Mahieu, E., Jones, N., Griffith, D. W. T., Smale, D., and Robinson, J.: *Tropospheric water vapour isotopologue data ($H_2^{16}O$, $H_2^{18}O$ and $HD^{16}O$) as obtained from NDACC/FTIR solar absorption spectra*, Earth Syst. Sci. Data, 9, 15-29, 2017
- Velazco V. A., Morino, I., Uchino O., Hori A., **Kiel, M.**, Bukosa, B., Deutscher, N. M., Sakai, T., Nagai, T., Bagtasa, G., Izumim, T., Yoshida, Y., and Griffith, D. W. T.: *TCCON Philippines: First Measurement Results, Satellite Data and Model Comparisons in Southeast Asia*, Remote Sens., 9, 1228, 2017
- Wunch, D., Wennberg, P. O., Osterman G., Fisher, B., Naylor, B., Roehl, C. M., O'Dell C., Mandrake, L., Viatte, C., **Kiel, M.**, et al.: *Comparisons of the Orbiting Carbon Observatory-2 (OCO-2) XCO₂ measurements with TCCON*, Atmos. Meas. Tech., 10, 2209-2238, 2017
- 2016 **Kiel, M.**, Hase, F., Blumenstock, T., and Kirner, O.: *Comparison of XCO abundances from the Total Carbon Column Observing Network and the Network for the Detection of Atmospheric Composition Change measured in Karlsruhe*, Atmos. Meas. Tech., 9, 2223-2239, 2016
- Hase, F., Frey, M., **Kiel, M.**, Blumenstock, T., Harig, R., Keens, A., and Orphal, J.: *Addition of a channel for XCO observations to a portable FTIR spectrometer for greenhouse gas measurements*, Atmos. Meas. Tech., 9, 2303-2313, 2016
- Kiel, M.**, Wunch, D., Wennberg, P. O., Toon, G. C., Hase, F., and Blumenstock, T.: *Improved retrieval of gas abundances from near-infrared solar FTIR spectra measured at the Karlsruhe TCCON station*, Atmos. Meas. Tech., 9, 669-682, 2016
- 2015 Hase, F., Frey, M., Blumenstock, T., Groß, J., **Kiel, M.**, Kohlhepp, R., Mengistu Tsidu, G., Schäfer, K., Sha, M. K., and Orphal, J.: *Application of portable FTIR spectrometers for detecting greenhouse gas emissions of the major city Berlin*, Atmos. Meas. Tech., 8, 3059-3068, 2015
- Frey, M., Hase, F., Blumenstock, T., Groß, J., **Kiel, M.**, Mengistu Tsidu, G., Schäfer, K., Sha, M. K., and Orphal, J.: *Calibration and instrumental line shape characterization of a set of portable FTIR spectrometers for detecting greenhouse gas emissions*, Atmos. Meas. Tech., 8, 3047-3057, 2015
- 2014 Porz, S., **Kiel, M.**, and Lehnertz, K.: *Can spurious indications for phase synchronization due to superimposed signals be avoided?*, Chaos, 24, 033112, 2014

SELECTED PRESENTATIONS

- 2019 **American Geophysical Union Fall Meeting, San Francisco, CA, USA**
Kiel, M., Laughner, J., Eldering, E., Fisher, B., Kurosu, T., Pavlick, R., Osterman, G., Nelson, R., O'Dell, C. W., Somkuti P., Taylor, T., Roehl C., and the TCCON team: *First Comparison of OCO-3 XCO₂ Measurements with TCCON*, 12/2019, Oral
- Annual NDACC-IRWG and TCCON Meeting, Wanaka, New Zealand
Kiel, M., Laughner, Wunch, D.: *GGGNext*, 05/2019, Oral
- 2018 **American Geophysical Union Fall Meeting, Washington D.C., USA**
Kiel, M., Fisher B., O'Dell C., Eldering A., Chapsky L. and Wennberg P. O.: *Reduction of Topography related Biases in OCO-2 V9 Data*, 12/2018, Poster
- Annual NDACC-IRWG and TCCON Meeting, Mexico City, Mexico
Kiel, M., Liu, J., Wennberg O. P.: *Variations of XCO₂ anomalies over the European continent observed from OCO-2 and TCCON*, 6/2018, Oral
- 14th International Workshop on Greenhouse Gas Measurements from Space (IWGGMS), Toronto, Canada
Kiel, M., Fisher, B., Wennberg O. P.: *Correction of topography related biases in XCO₂ measurements from OCO-2*, 5/2018, Oral
- 2017 **American Geophysical Union Fall Meeting, New Orleans, LA, USA**
Kiel, M., Roehl, C. M., Wunch D., Osterman, G. B., and Wennberg, P. O.: *OCO-2 target-mode observations and comparison to TCCON*, 12/2017, Poster
- 13th International Workshop on Greenhouse Gas Measurements from Space, Helsinki, Finland
Roehl, C. M., **Kiel, M.**, Wennberg, P. O., Wunch, D., and Osterman, G.: *Update on OCO-2 Validation Using TCCON*, 6/2017, Poster
- Annual NDACC-IRWG and TCCON Meeting, Paris, France
Kiel, M., Toon, G. C., Wunch, D., Mendonca, J., and Wennberg, P. O.: *Airmass dependent correction factors and Xair dependence*, 6/2017, Oral
- 2016 **European Geosciences Union Gen. Assembly, Vienna, Austria**
Kiel, M., Hase, F., Blumenstock, and T., Kirner, O.: *Comparison of XCO abundances measured in the MIR (NDACC) and NIR (TCCON) using Karlsruhe Fourier Transform Infrared (FTIR) measurements*, 4/2016, Poster
- 2015 **American Geophysical Union Fall Meeting, San Francisco, CA, USA**
Kiel, M., Hase, F., and Blumenstock, T.: *Comparison of MIR (NDACC) and NIR (TCCON) column-averaged CO from ground-based solar Fourier Transform Infrared (FTIR) measurements*, 12/2015, Poster
- 2014 **NORS/GAW/NDACC Meeting, Brussels, Belgium**
Kiel, M., Blumenstock, and T., Hase, F.: *MIR and NIR comparisons of trace gas retrievals based on FTIR operation in Karlsruhe*, 10/2014, Oral